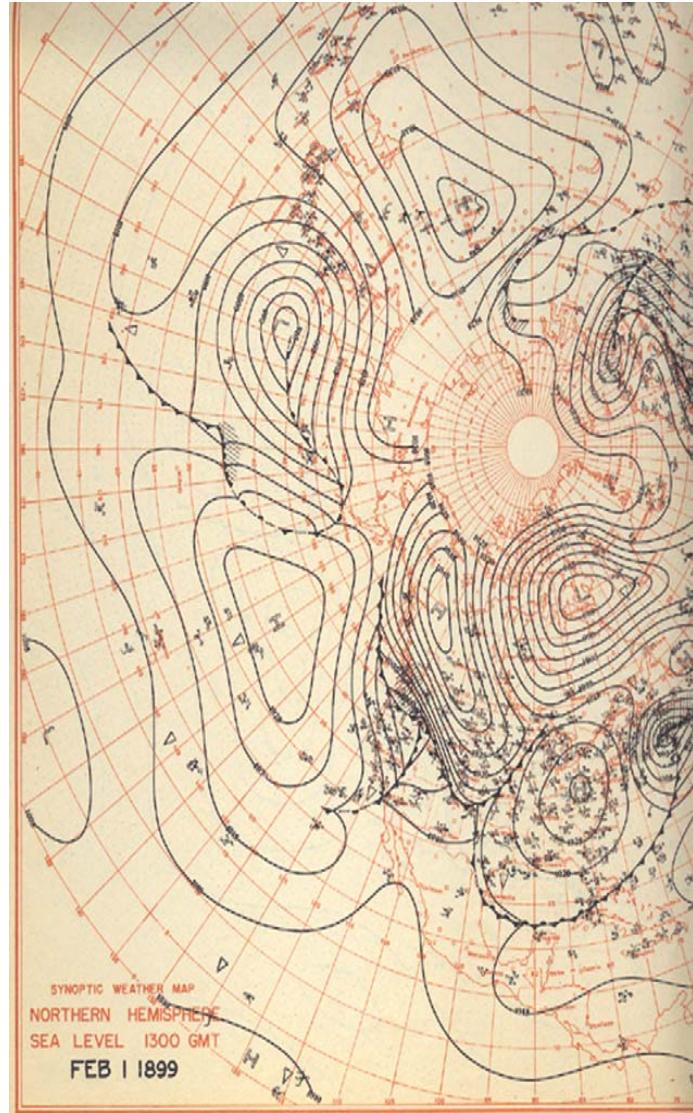


***Climatology and variability of rainfall  
in the  
20<sup>th</sup> Century Reanalysis***

**Michela Biasutti and Dong Eun (Donna) Lee**

Lamont Doherty Earth Observatory of Columbia University

# The 20<sup>th</sup> Century Reanalysis, version 2 (Compo et al.)



- Uses the **NCEP atmospheric-land GCM**
- Hadley Center **SST and sea ice** as boundary conditions
- Assimilates only **surface pressure observations**
- Spans **1871 to 2008**
- Uses an Ensemble Kalman Filter **(producing 56 realizations)**

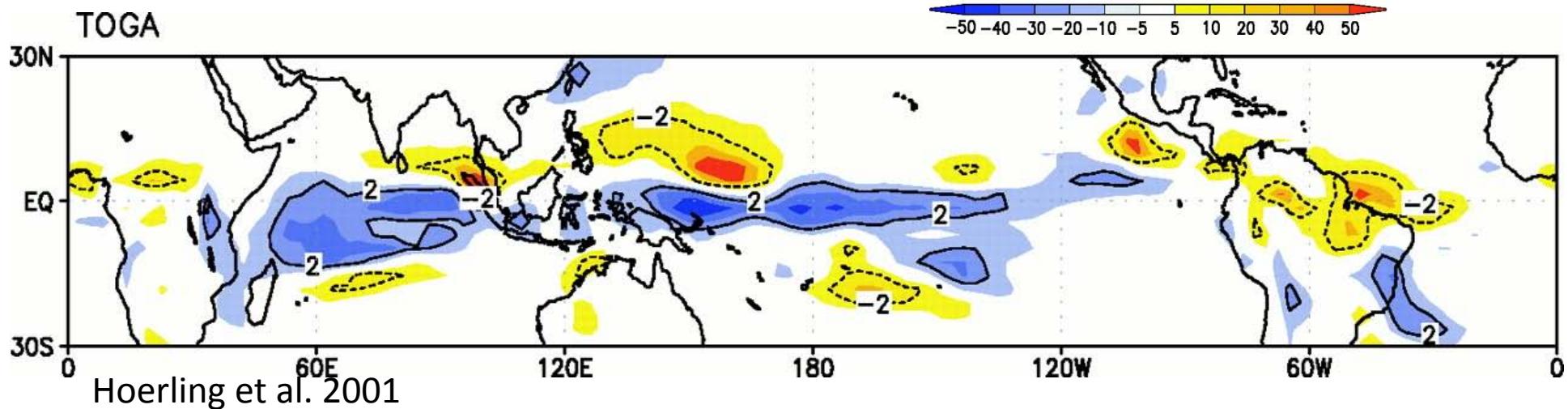
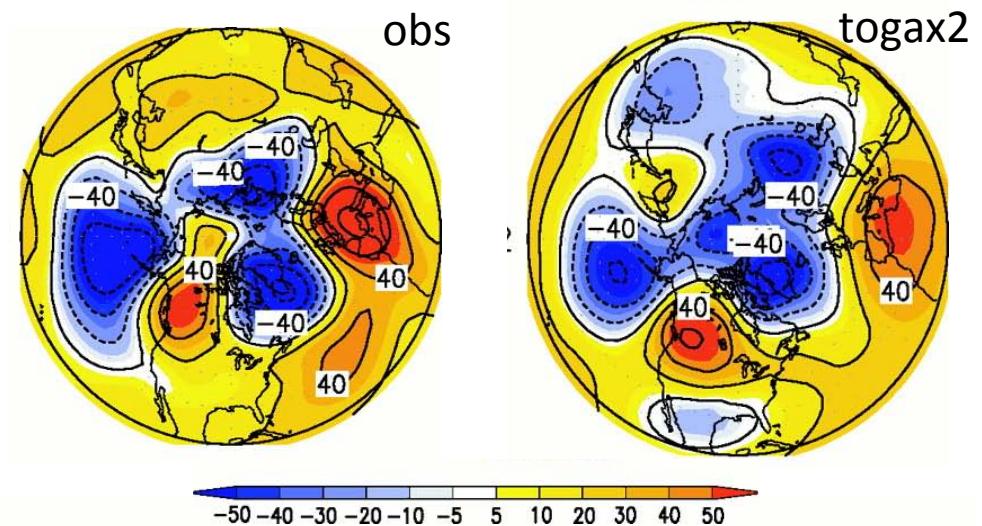
## **Why focus on (tropical) rainfall?**

Attribution of climate trends require knowing the trends in oceanic precipitation. Can the 20CRv2 fill the gaps?

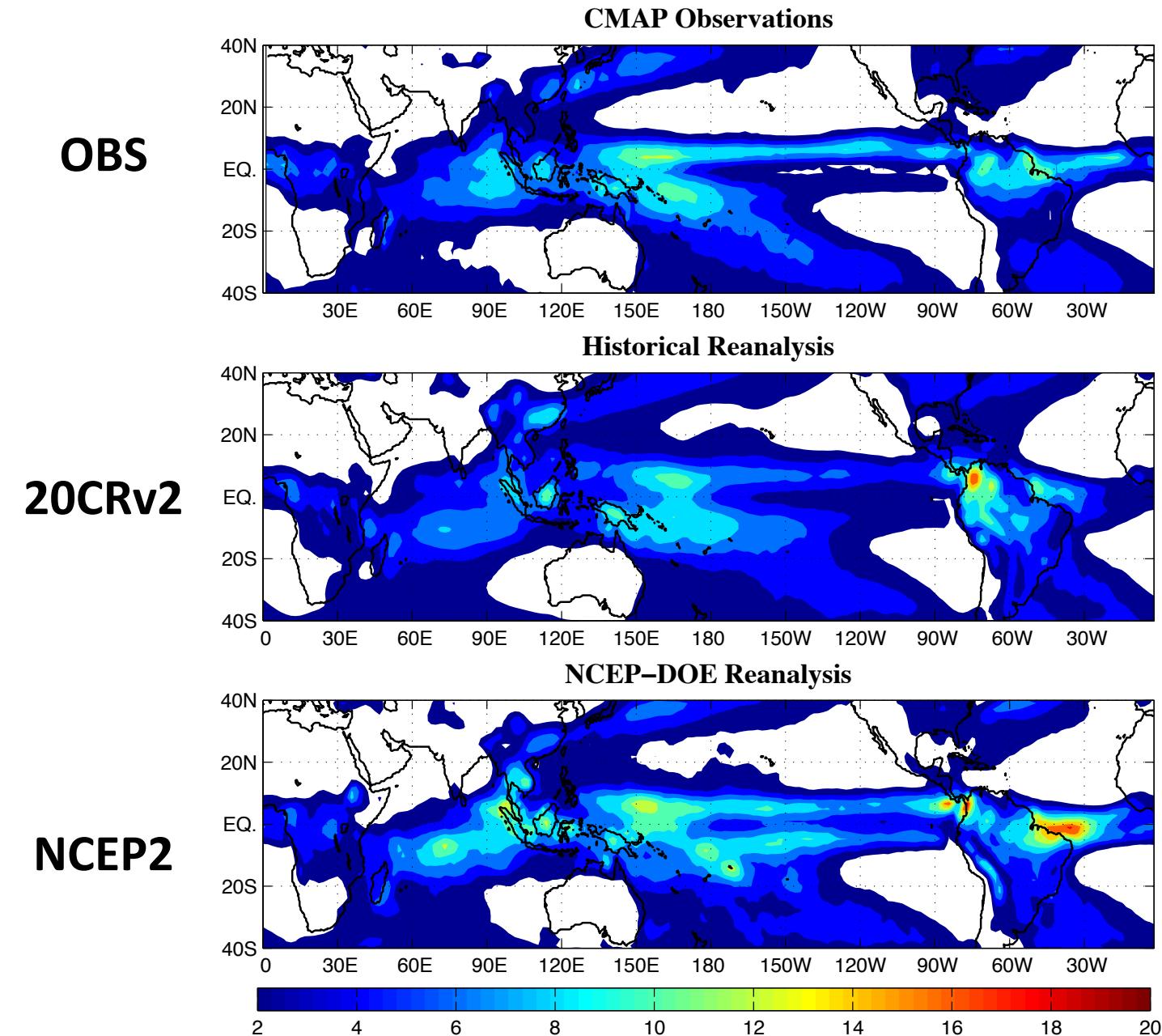
# Why focus on (tropical) rainfall?

Attribution of climate trends require knowing the trends in oceanic precipitation. Can the 20CRv2 fill the gaps?

**Example:** the idea that trends in the NAO are forced by the warming of the Indian Ocean rests on simulations that produce enhanced rainfall for warmer SST. Can we confirm or reject this link?



# Climatology: MAM seasonal means

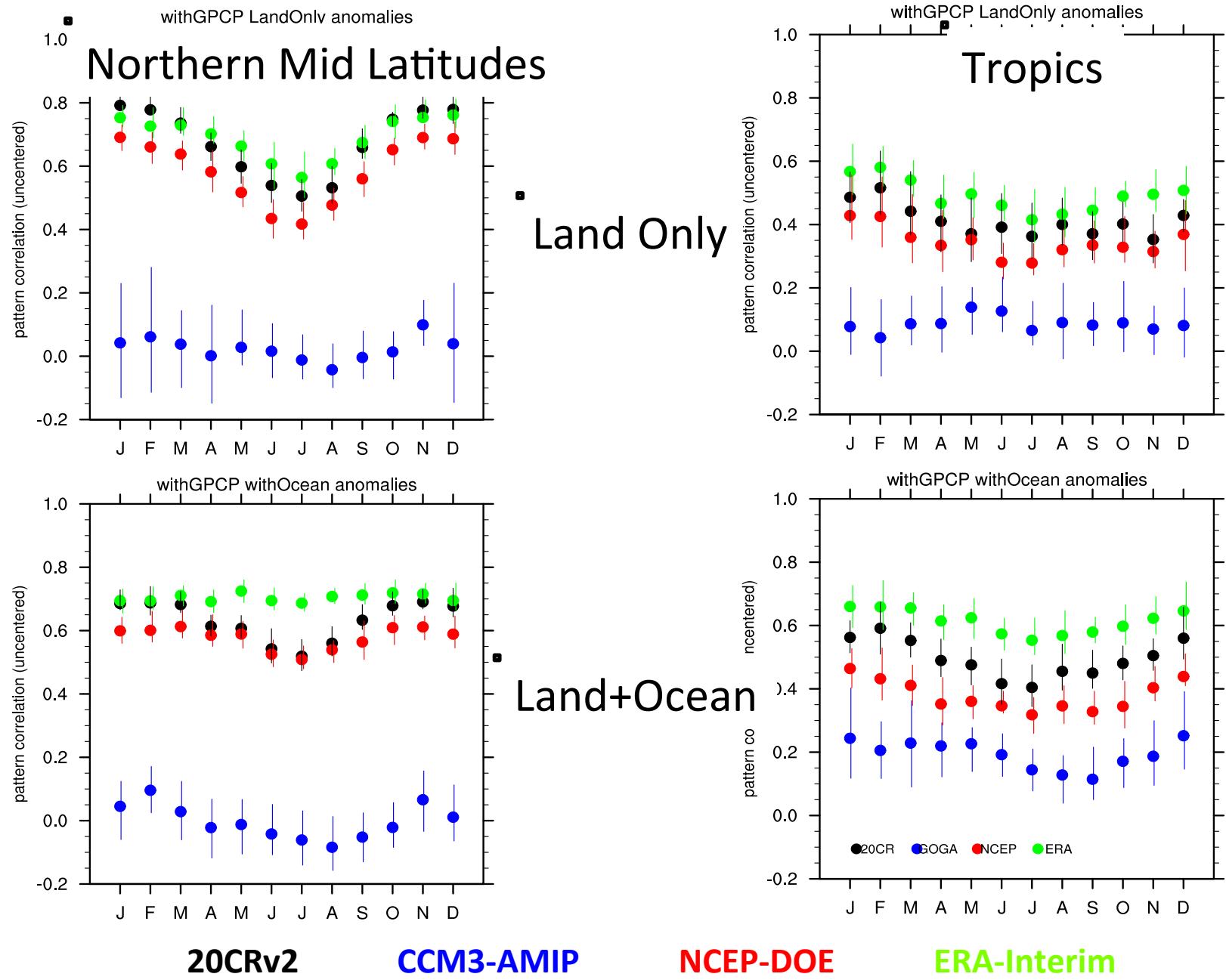


## Variability of seasonal means:

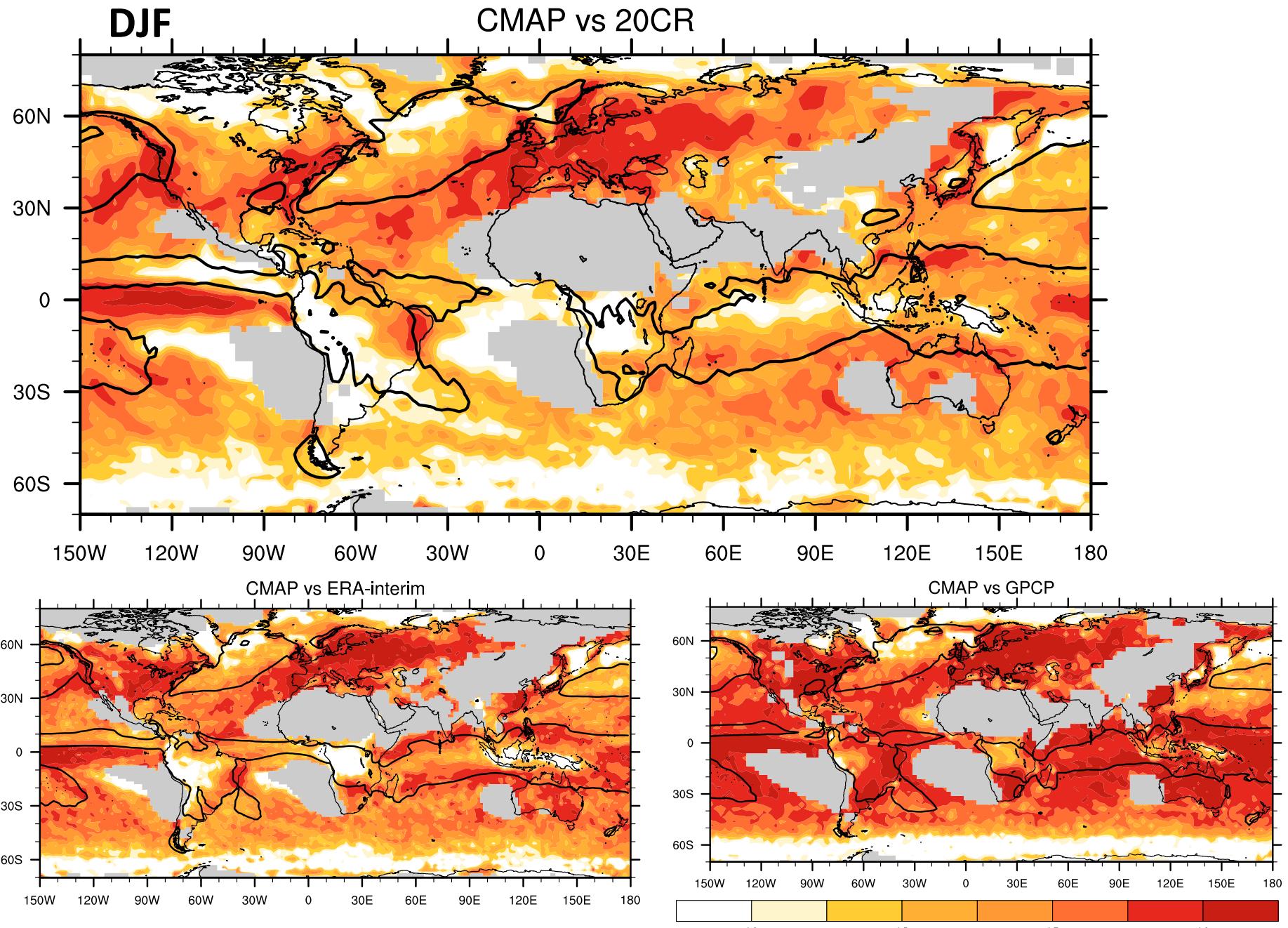
### Can we trust the 20CRv2 estimates for the pre-satellite era?

1. Does the 20CRv2 reproduce the rainfall anomalies (land and ocean) over the satellite era?
2. How does it compare with (i) models that only know SST and (ii) reanalyses that assimilate more data?
3. How important is the quality and density of the assimilated data, that is, how much does the fit with observations vary over time?

# Seasonal cycle of the anomaly pattern correlation over 1979-2008

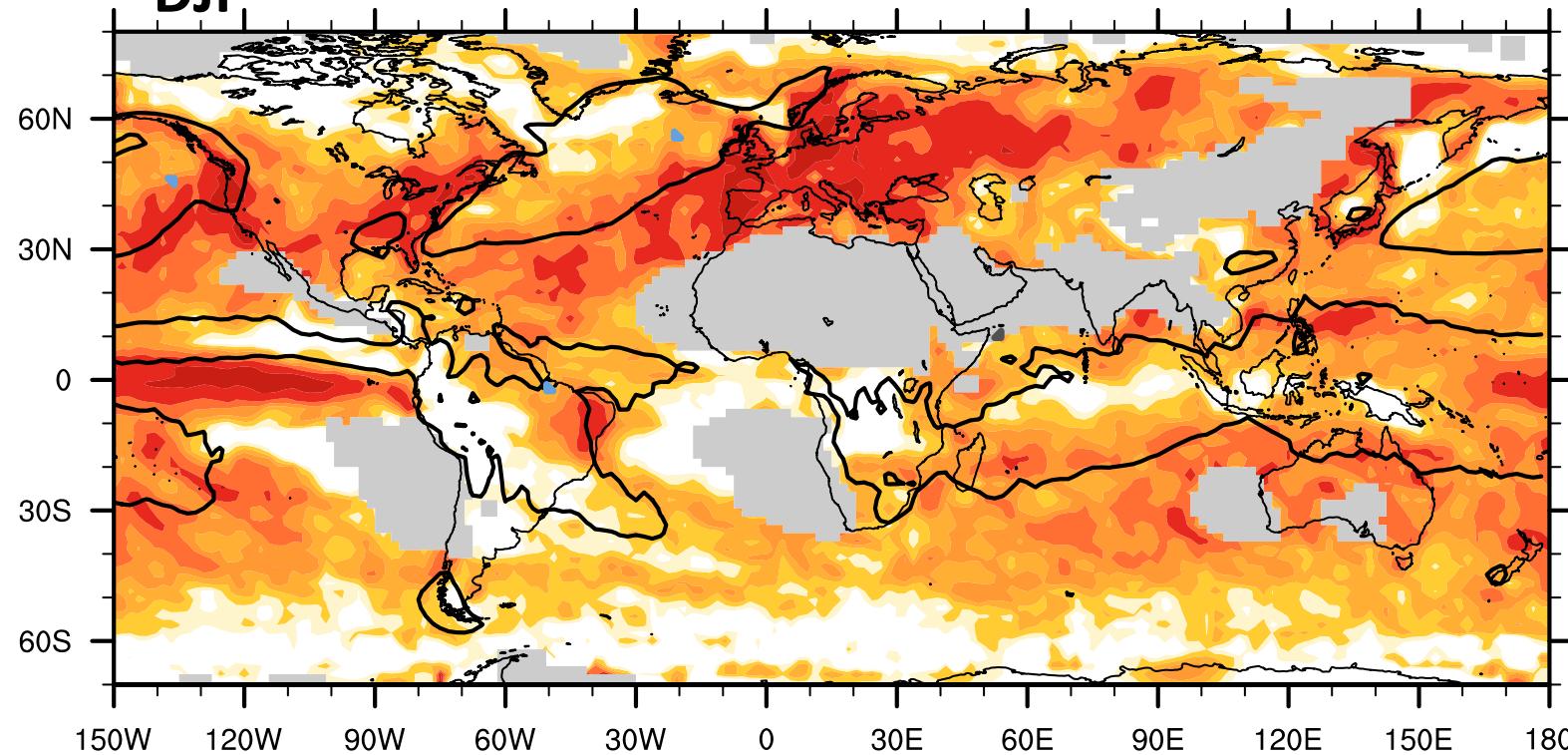


# Temporal anomaly correlation over 1979-2008

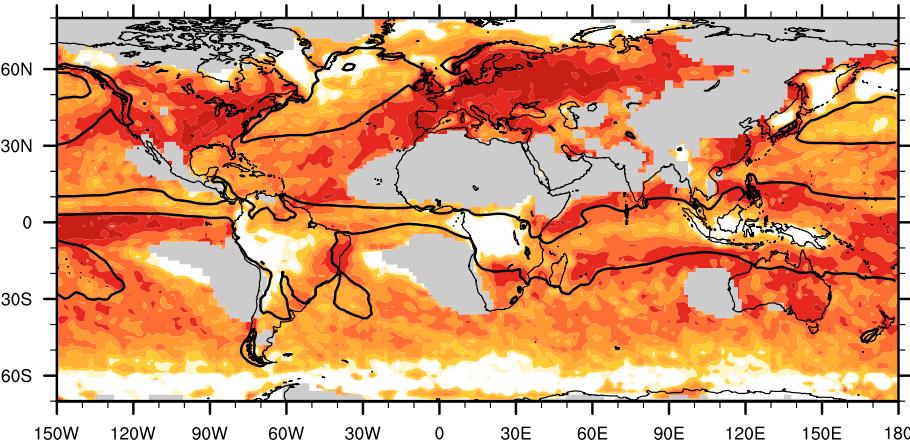


DJF

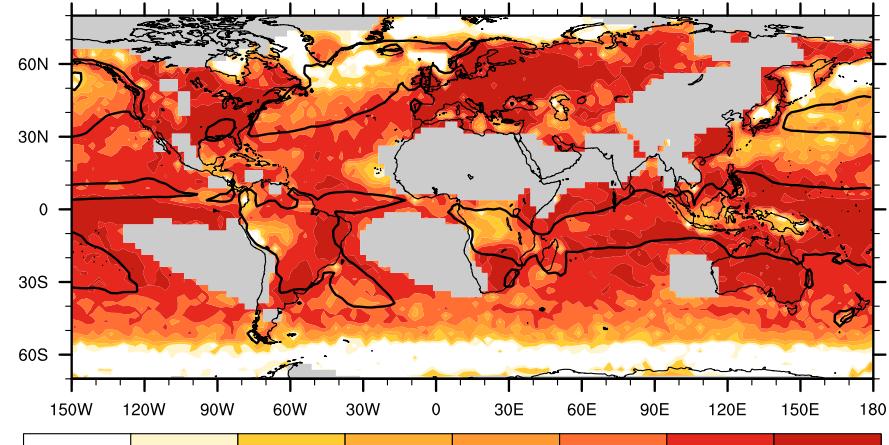
CMAP vs 20CR



CMAP vs ERA-interim

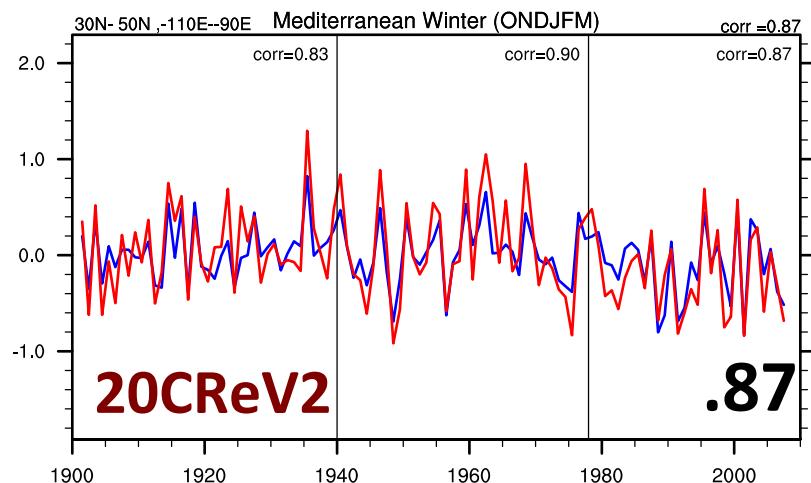


CMAP vs GPCP

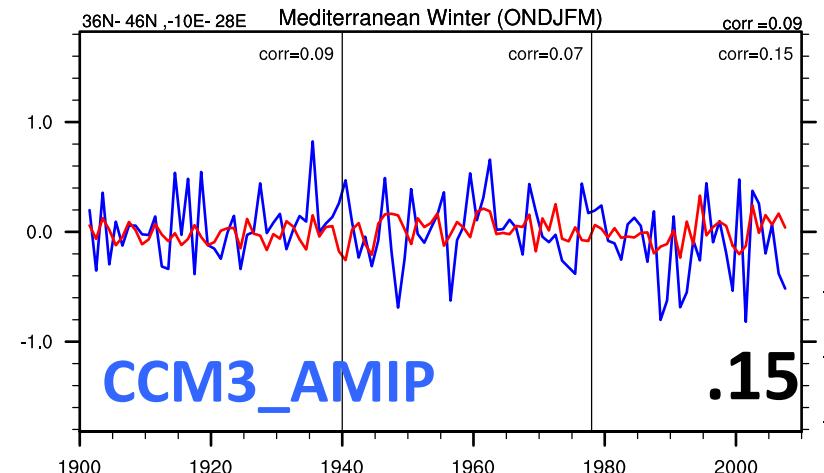


# Mediterranean Winter

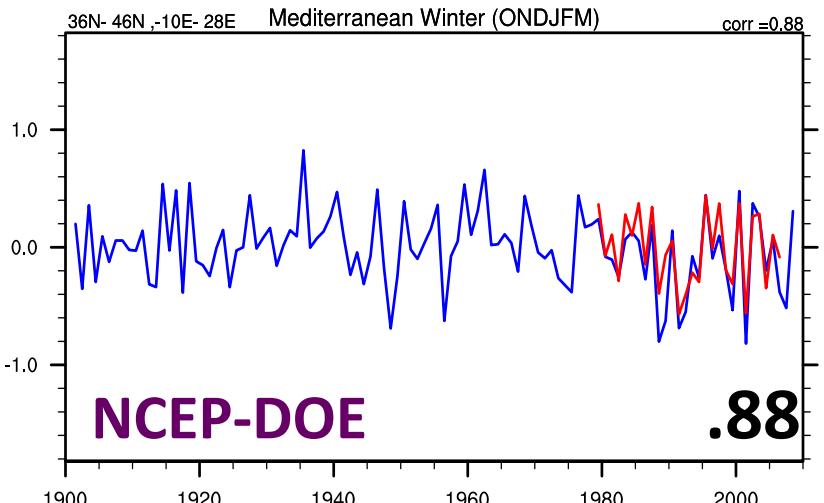
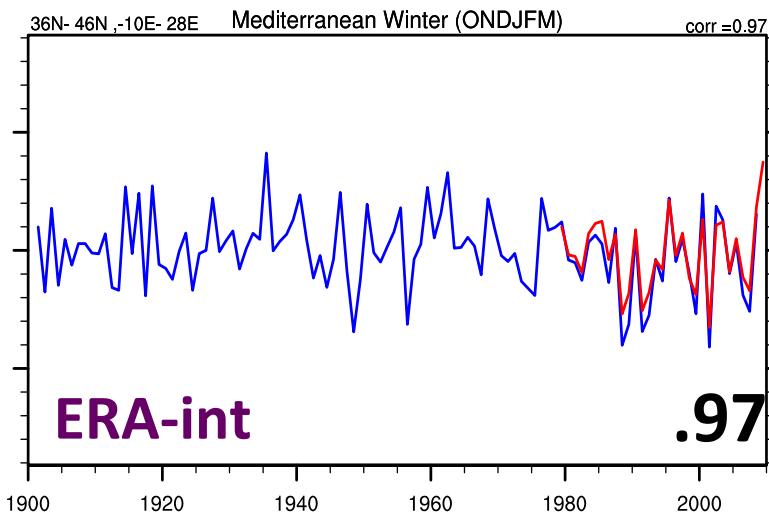
SST + SLP



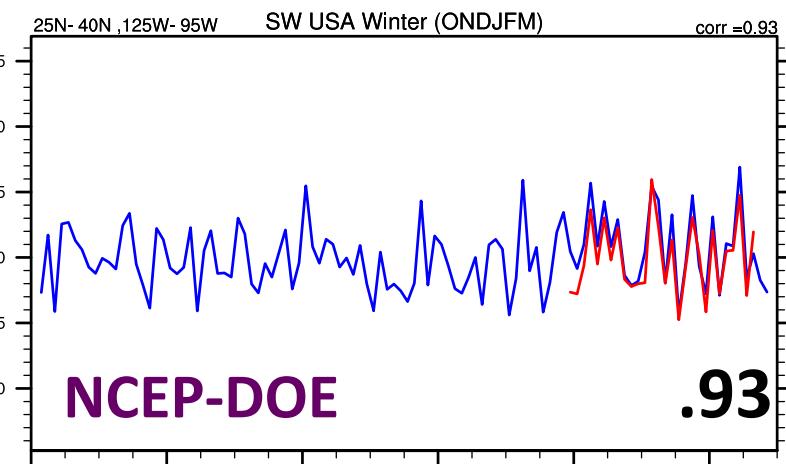
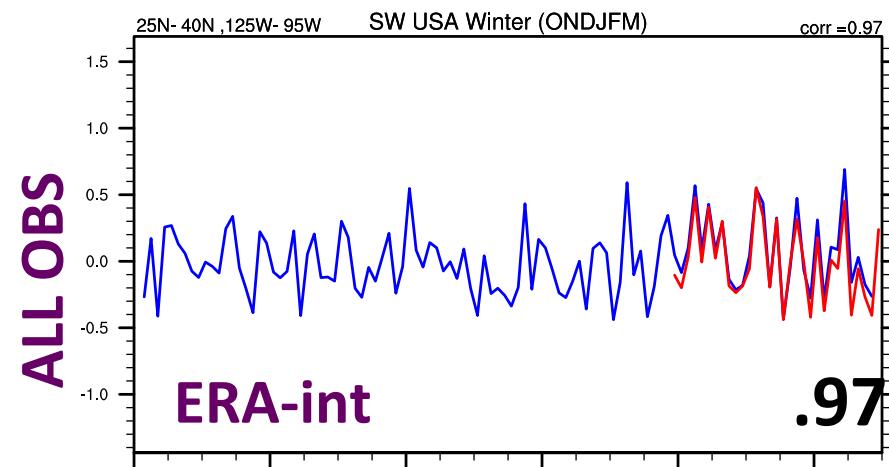
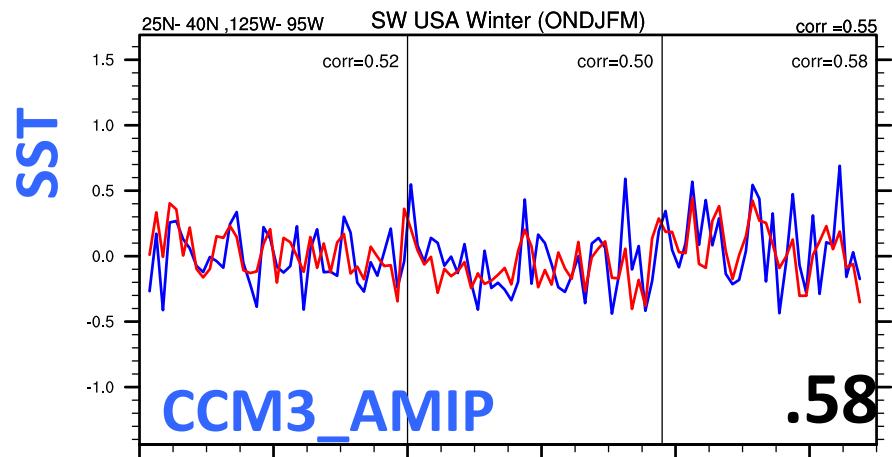
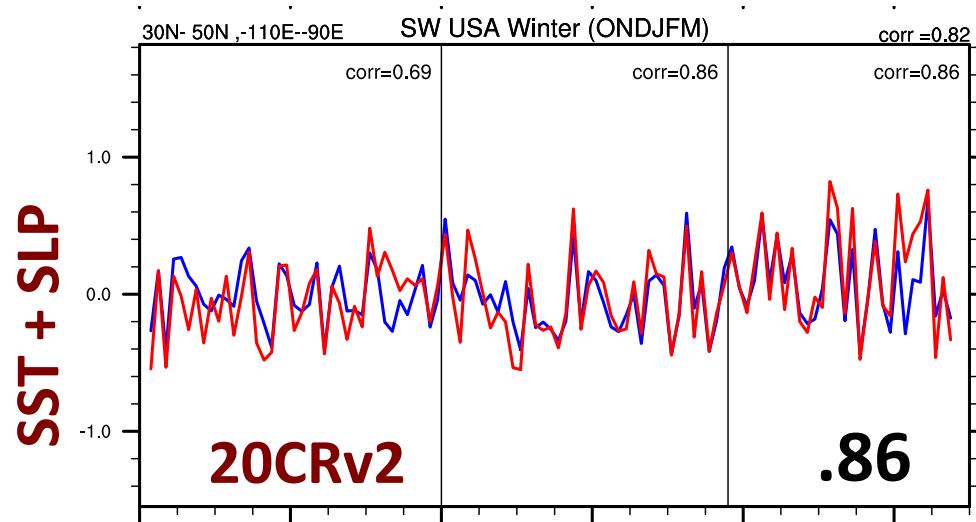
SST



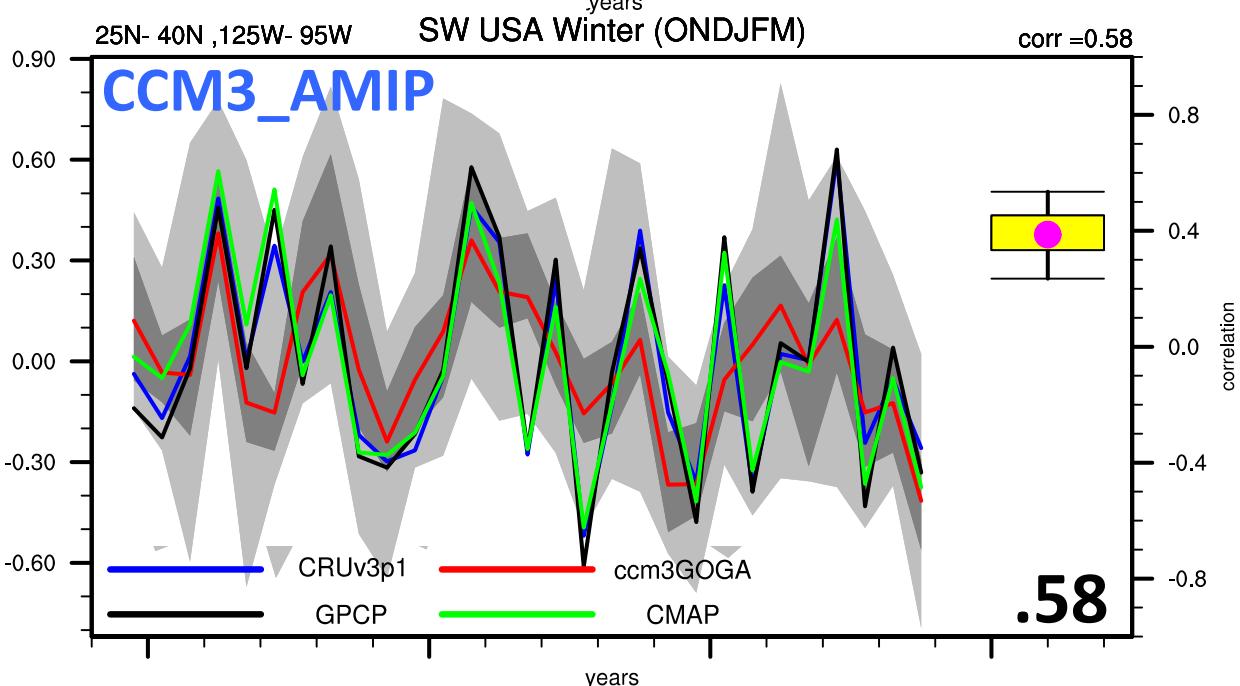
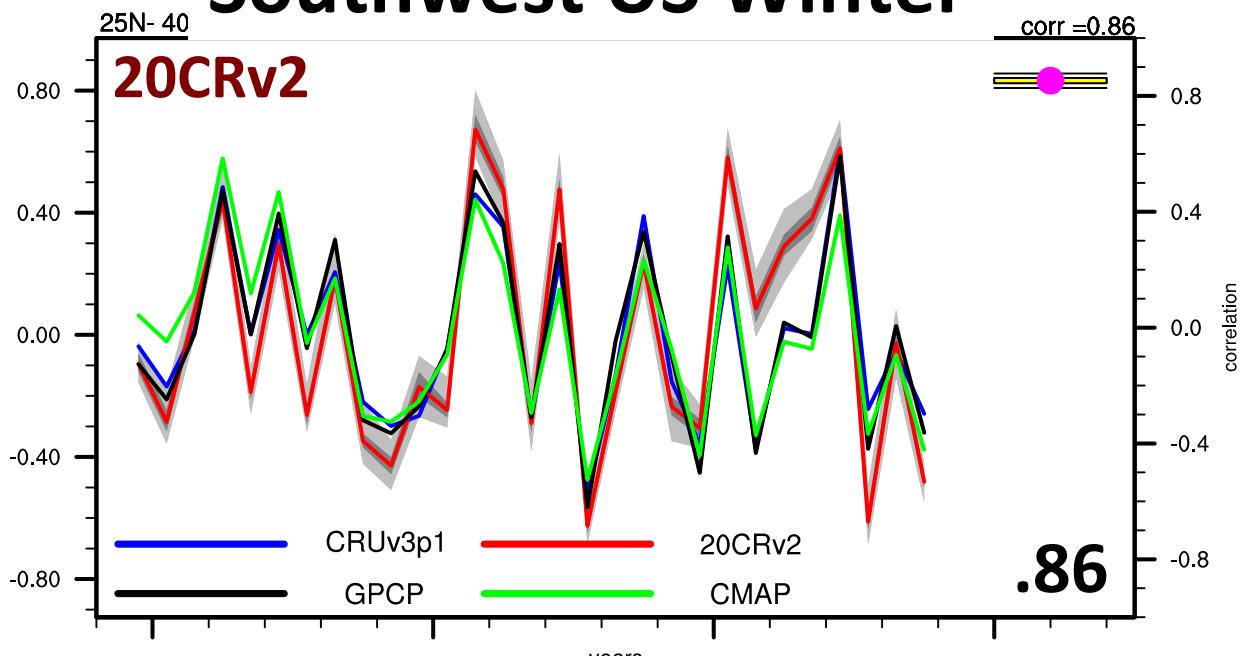
ALL OBS



# Southwest US Winter

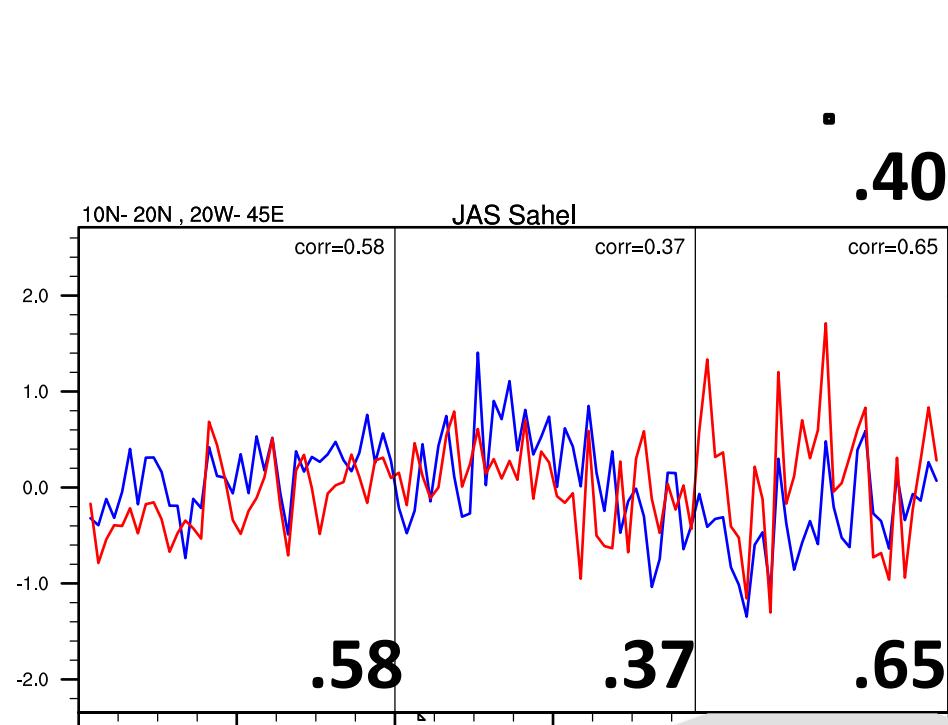


# Southwest US Winter



Each 20CRv2 ensemble member tracks observations as well as the ensemble mean. Largest spread and worst fit go together.

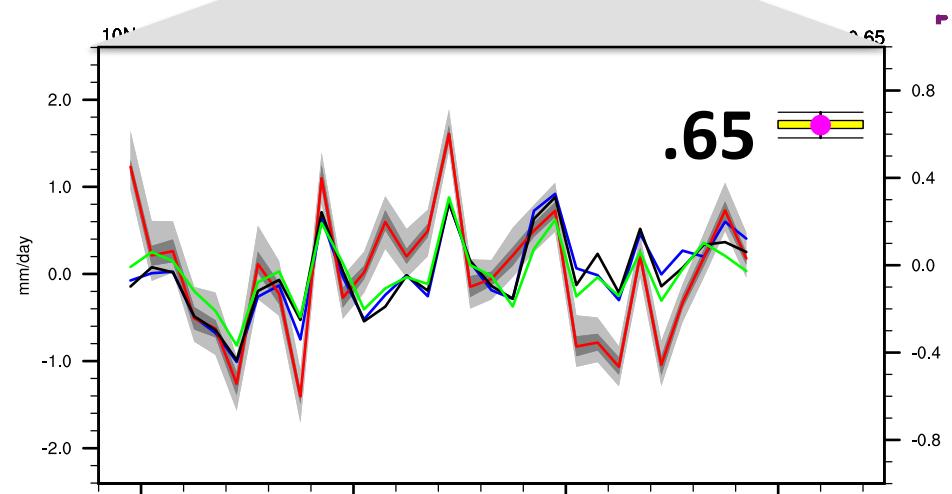
# How does 20CRv2 perform in the Sahel?



CCM3 · > .21

AM2 · > .60

NSIPP1 · > .60

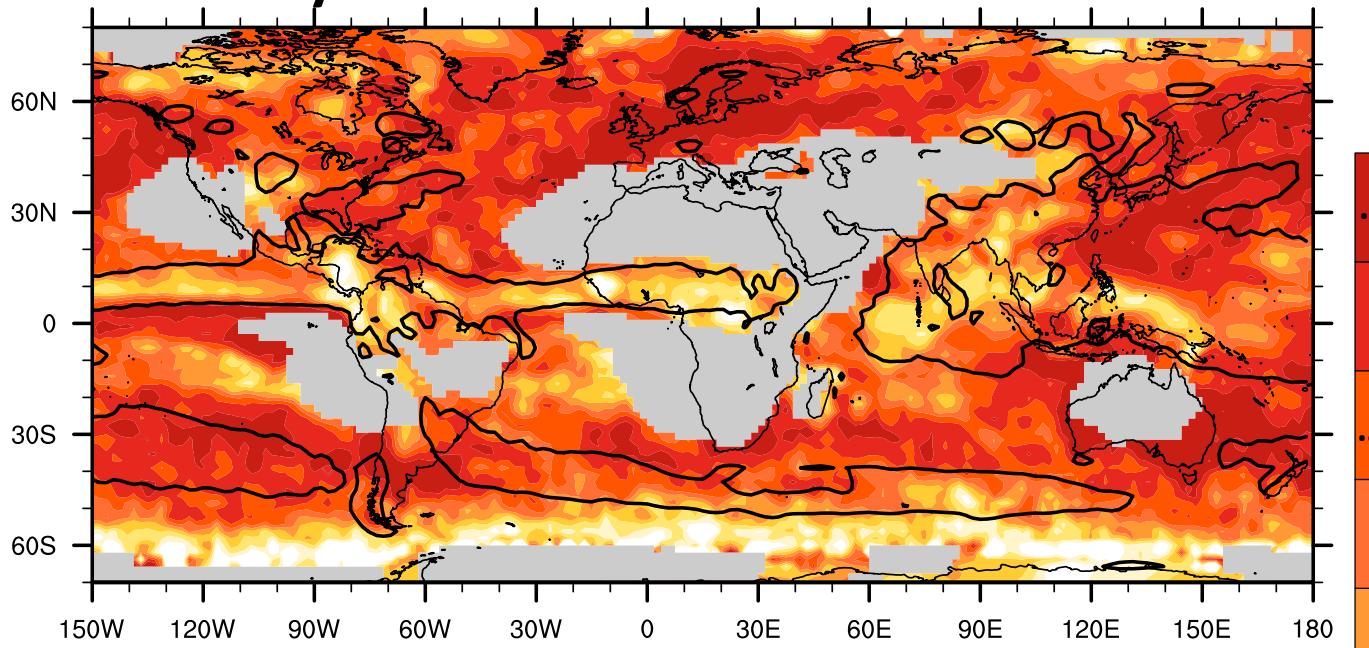


ERA-I · > .15

NCEP-II · > .71

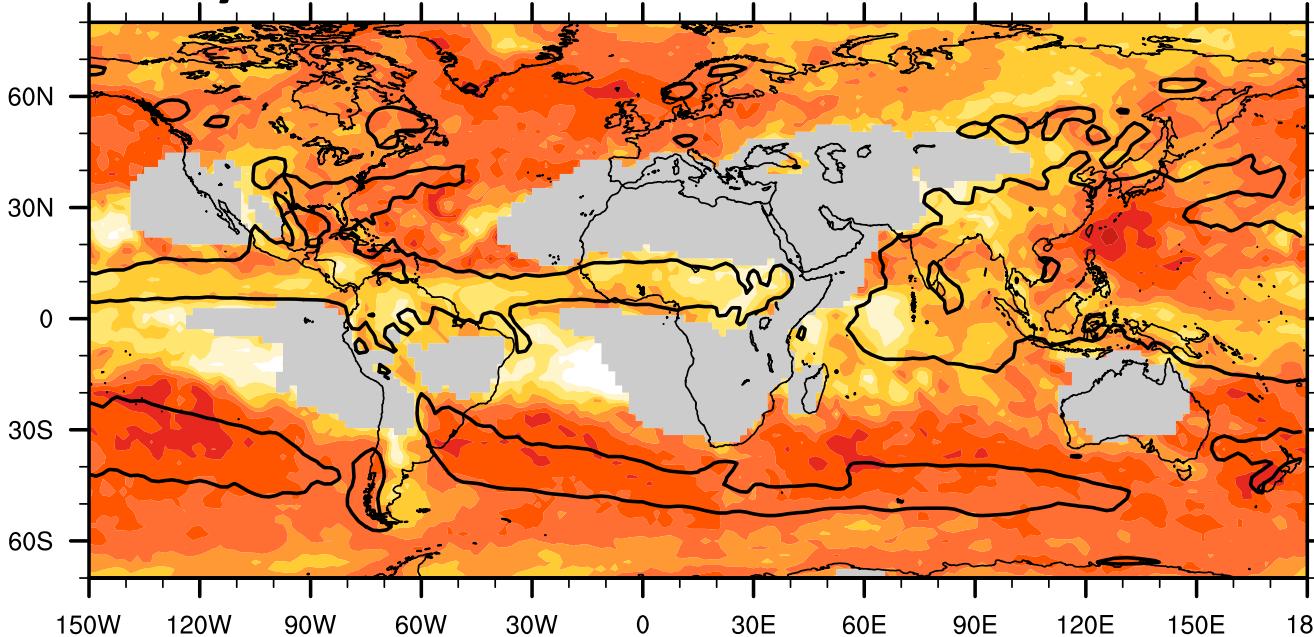
**Monthly JJA**

CMAP vs 20CR



**Daily JJA**

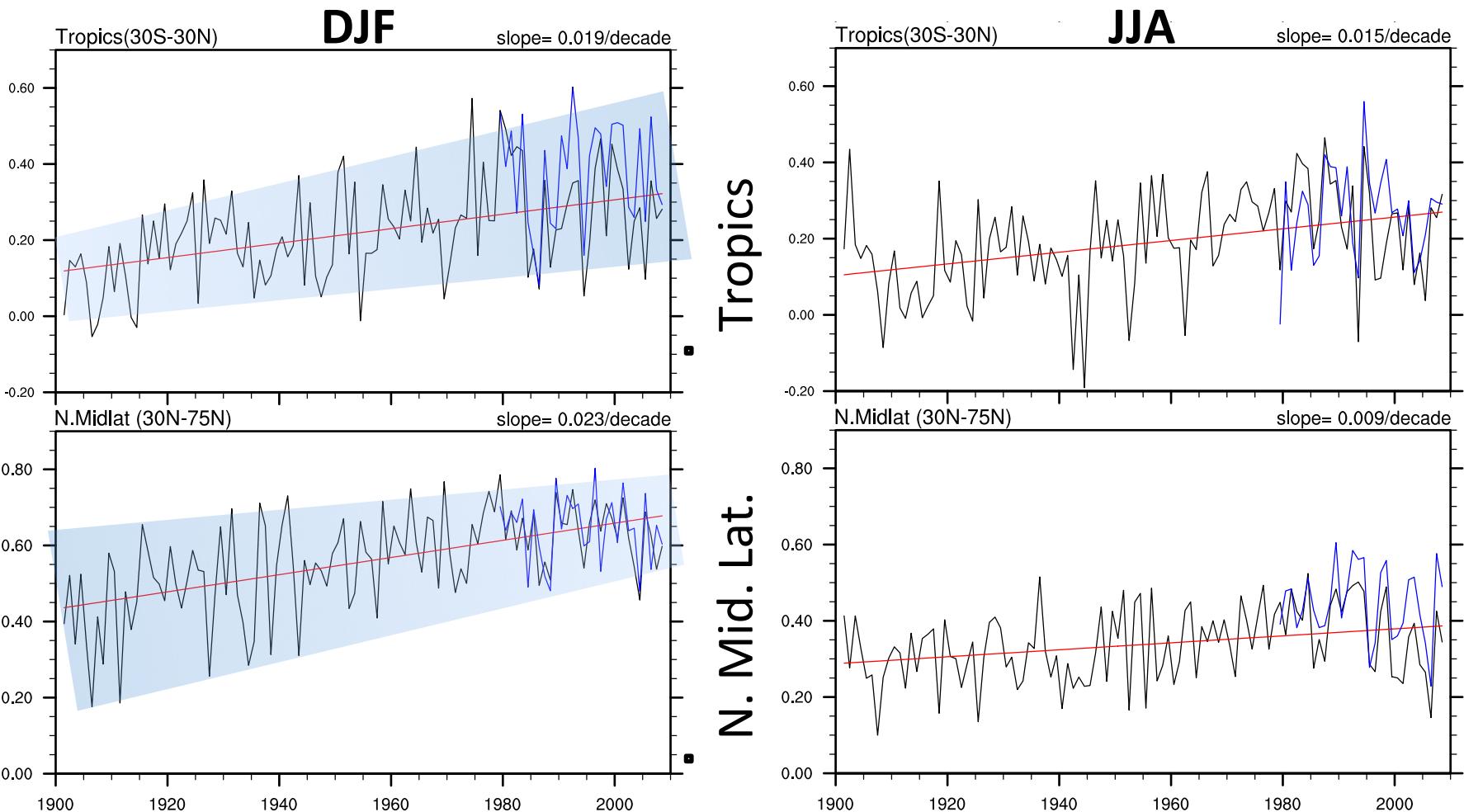
GPCP vs 20CR



In tropical locations, the best skill is at the edge of the convection centers, indicating that the 20CRv2 might be used to track the ITCZ location.

The skill at daily timescale has similar pattern, if overall lesser values.

# Time evolution of regional pattern correlations (20CRv2,OBS) for seasonal mean rainfall



**CRU TS3p1 ; CMAP**

## Conclusions:

20CRv2 captures the winter variability of rainfall in the mid-latitudes with great accuracy (comparable to ERA-interim).

Summer rainfall and tropical rainfall are not captured well enough to constrain the long-term trends.

The skill at the edge of the ITCZ suggests that the 20CRv2 might be used to track the position of convective centers (albeit probably not their intensity).

More observations can further improve the 20CRv2 performance, but even a sparse record is sufficient to constrain seasonal variability in the winter mid-latitudes.